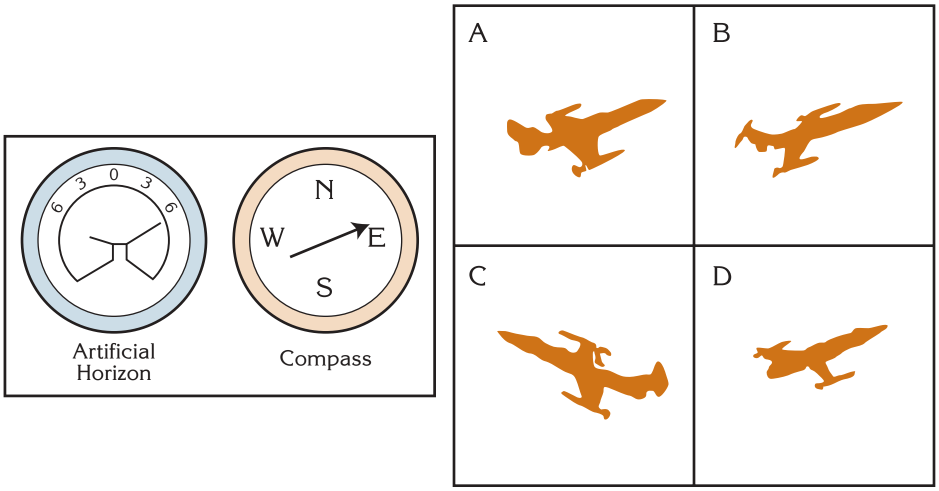
Volume XIII: Number 1 (2002)

Human Systems IAC

GATEWAY

Published by the Human Systems Information Analysis Center



Directions:
This test measures your ability to determine the position of an airplane in flight from reading instruments showing its compass heading, amount of climb or dive, and degree of bank to right or left.

Figure 1. U.S. Air Force AFOQT Instrument Comprehension Test.

Common Military Pilot Selection Practices

Dr. Thomas R. Carretta

The high costs associated with pilot training, aircraft, and aviation accidents demand that every effort be made to select the best pilot training candidates. Since WWI, a large amount of time, money, and effort have been spent by both military and commercial aviation to identify the characteristics needed to be a good pilot and the means to accurately measure those characteristics. The military has gone even further, attempting to determine whether a pilot would be better suited to fly fighter or nonfighter aircraft.

Military pilot applicants typically have little or no prior flying experience and may not have had prior exposure to the military. Commonly used selection factors include measures of ability (e.g., academic performance, standardized test scores), medical qualification, indicators of "officership" (e.g., commander's ratings from an officer training program), and prior flying experience (e.g., hours flown, private pilot's certificate). Personality assessment (e.g., psychological interview) is done in some military organizations, but is less common.

Selection into military pilot training is a multistage process in which decisions are made at several points. Weeks and Zelenski (1998) identified nine barriers to entry into U.S. Air Force pilot training. Barriers included demonstration of minimum educational achievement, interest in the military, interest in the Air Force, officer qualification, officer selection, desire to fly, flying training qualification, pilot training selection, and successful completion of flight screening. The order of overcoming these barriers varies across individuals. For instance, some may know at an early age that they wish to become a pilot. Their occupational

continued on next page

http://iac.dtic.mil/hsiac

inside:

The Human Systems IAC is a United States Department of Defense Information Analysis Center administered by the Defense Technical Information Center, Ft. Belvoir, VA, technically managed by the Air Force Research Laboratory Human Effectiveness Directorate, Wright-Patterson Air Force Base, OH, and operated by Booz Allen Hamilton, McLean, VA.

continued from previous page

choice then drives subsequent decisions regarding education and military service. Others choose a career with the military as a means to finance their education, and only later decide to become an officer and pursue a career as a pilot. Another example is the timing and role of flight screening programs. Some pilot applicants attend flight screening after being chosen to enter pilot training. Others attend flight screening programs at an earlier stage, perhaps prior to completion of an officer-commissioning program. Although qualification standards and selection methods vary widely, these barriers are representative of many military pilot selection programs.

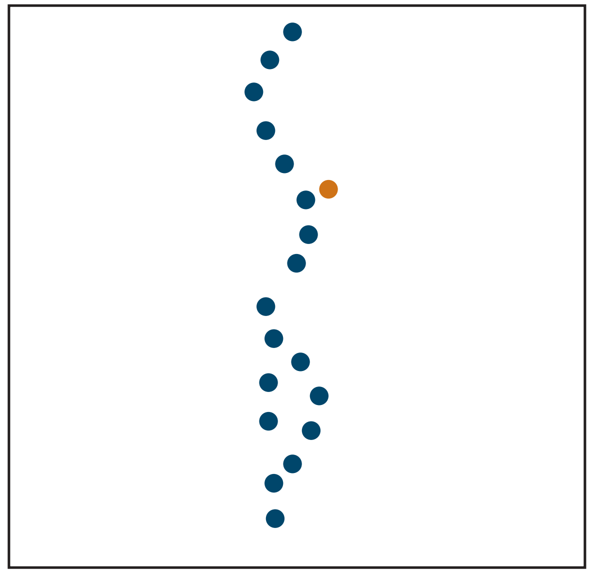
Are Effective Pilots "Selected" or "Trained"?

In the U.S. military, the roles of selection, training, and human factors in pilot performance are often treated as independent. This is unfortunate as they are interrelated. Poor selection will result in higher training attrition, increased training costs, and a lower level of job performance. Conversely, analyses of pilot tasks should be used to identify critical selection factors.

Cockpit design affects pilot performance and training requirements. Poor pilot-vehicle interface (PVI) designs will increase pilot cognitive demands, workload, and errors. Further, the Real-Time Information to the Cockpit (RTIC)[1] concept may increase pilot information-processing requirements and workload. Poor PVI designs and RTIC will result in increased selection (e.g., intelligence, working memory) and training requirements (i.e., more training needed to learn to use a poor PVI).

Military Pilot Selection Procedures—Cumulative Evidence

The critical knowledge, skills, abilities, and other characteristics needed to be a successful pilot have changed as aircraft systems have become more complex. Modern aircraft operation is less dependent on stick-and-rudder skills, placing greater demands on cognitive ability. Cumulative evidence points to measures of general cognitive ability (*g*) as the most important construct in the prediction of pilot training performance (Ree & Carretta, 1996).



Directions:
In this single-dimensional tracking task, the participant uses a control stick to move a cursor left or right to hit the target circles as they scroll down the screen.

Figure 2. UK RAF Control of Velocity Test.

Other constructs, such as flying job knowledge, psychomotor ability, and personality have been shown to add to the predictiveness of *g*. This is consistent with results from mainstream personnel selection studies (Schmidt & Hunter, 1998) that show *g* is the most useful predictor of training and job performance across many occupations and that work sample, job knowledge, integrity, and conscientiousness tests, and structured interviews may increment the predictiveness of *g*.

There are several ways to measure these constructs. The most common in military aviation are multiple aptitude paper-and-pencil tests, computerized tests, and interviews. Computer-based and simulator-based job sample tests are sometimes used, but are less common.

Examples of Current Practices

U.S. military. There has been little innovation in U.S. military pilot selection procedures since the early 1990s when the Army, Navy, and Air Force each introduced new pilot selection tests.[2] At that time, the U.S. Air Force implemented a computerized test known as the Basic Attributes Test (BAT) as an adjunct to operational selection procedures. BAT psychomotor, information processing, and personality scores are combined with the Air Force Officer Qualifying Test (AFOQT) Pilot composite and a measure of prior flying experience to create a pilot aptitude composite called the Pilot Candidate Selection Method (PCSM). The predictiveness of the AFOQT for pilot training performance comes almost entirely from its measurement of *g* and aviation job knowledge (Olea & Ree, 1994). In the PCSM equation, the validity of the AFOQT is incremented by the BAT psychomotor and personality scores and a measure of flying experience (Carretta & Ree, 1994).

A follow-on program to develop the next generation of U.S. Air Force computerized aviation selection tests was discontinued in 1997 when the Air Force Research Laboratory was reorganized and several programs, including many manpower and personnel research efforts, were canceled. U.S. Army and U.S. Navy pilot selection research and development (R&D) efforts have been stifled by similar cutbacks. However, new forms of the AFOQT continue to be developed and implemented about every seven years.

Non-U.S. military. That is not to say that pilot selection R&D is not flourishing elsewhere. The UK Royal Air Force (RAF) has an active aircrew selection R&D program. Historically, the RAF has relied heavily on ability measurement for job specialties such as pilot and on measures of personality/character and biographical information for overall officer suitability (Bailey & Woodhead, 1996). The RAF takes a "domain-centered" approach to aircrew selection. The emphasis is on first identifying the appropriate ability domains for a particular occupation (e.g., pilot, navigator, weapons director, air traffic controller) then choosing one or more tests to represent the critical domains. As the result of task analyses, the RAF identified six pilot ability domains:

- Attentional Capacity,
- Psychomotor,
- Reasoning (Numerical),
- Reasoning (Verbal),
- Spatial, and
- Work Rate.

RAF officer and aircrew selection procedures are thorough, involving two phases that take up to four days to complete.[3] Phase 1 activities include aptitude tests, a medical exam, and an interview. Two officers conduct the interview, which focuses on the applicant's achievements, motivation, and awareness of military and current affairs. Phase 2 includes a group discussion, individual and group problem solving exercises, a fitness test, and a final interview.

Although the use of multiple aptitude tests is common in pilot selection, others have proposed using simulator-based tests to improve selection procedures. The German Air Force combines the two approaches in a three-phase process (Hansen & Wolf, 2000). Phase 1, Military Aptitude and Academic Fitness, includes computer-assisted tests of intelligence and cognitive abilities, written

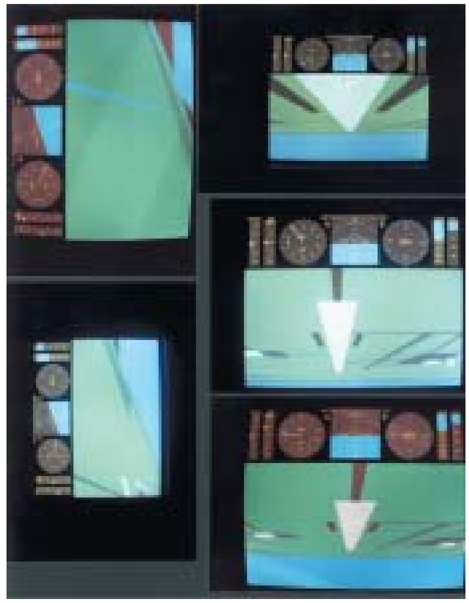


Figure 3. German Air Force FPS 80.

composition, oral presentation, group discussion, a physical fitness test, and an interview by two officers and a psychologist. Phase 2, Psychological and Medical Selection, includes computer-assisted cognitive, psychomotor, and personality tests, assessment center activities (leadership and organizational skills), a flight physical, and an interview by two psychologists and a staff officer. Interview content includes personality development, military career, ideas, values, and motivation, and motivation to fly. Phase 3 is assessment in the simulator-based Flight Psychological Selection (FPS 80) system. The FPS 80 is a low-fidelity simulator of a single-engine, propeller-driven aircraft. The flight model is based on a Piaggio 149D. Phase 3 begins with lectures on aerodynamics, navigation, and the FPS 80. Prior to flying their first "mission" in the FPS 80, applicants must pass a written test on this material. Gress and Willkomm (1996) demonstrated incremental validity for the FPS 80 beyond that provided by the basic psychological tests. Though Gress and Willkomm were encouraged by the incremental validity of the FPS 80, they identified several obstacles to the use of simulator-based tests including cost of the test system and test administration (e.g., centralized testing, amount of time needed).

For further information, please contact:

Dr. Thomas R. Carretta
Tel: (937) 656–7014
DSN: 986-7014
E-mail: thomas.carretta@wpafb.af.mil

Thomas R. Carretta, Ph.D.
Engineering Research Psychologist
Crew Systems Development Branch
Human Effectiveness Directorate
Air Force Research Laboratory
2210 8th Street, Bldg. 146
Wright-Patterson AFB, OH 45433–7511

Conclusion

Cumulative evidence has shown that measures of *g* have been and will likely continue to be a mainstay in military pilot selection batteries. Pilot job knowledge and psychomotor ability have shown incremental validity beyond cognitive ability. Results from large-scale meta-analyses of personnel selection (Schmidt & Hunter, 1998) suggest that additional increments may come from work sample, job knowledge, integrity, and conscientiousness tests, and from structured interviews.

Paper-and-pencil multiple aptitude batteries are useful for making a “first cut” as they are inexpensive to develop and administer. Interviews, computer-based tests, assessment center exercises, flight screening, and simulators are useful for measuring factors not easily assessed by paper-and-pencil tests.

The methods used to assess pilot aptitude are not so important. The bottom line for aviation psychologists is to know what constructs are important, then develop reliable selection methods and employ sound methodological procedures. ■

References

Bailey, M., & Woodhead, R. (1996). Current status and future developments of RAF aircrew selection. *Selection and Training Advances in Aviation: AGARD Conference Proceedings 588* (pp. 8-1–8-9). Prague, Czech Republic: Advisory Group for Aerospace Research & Development.

Carretta, T. R., & Ree, M. J. (1994). Pilot candidate selection method (PCSM): Sources of validity. *The International Journal of Aviation Psychology, 4*, 103–117.

Gress, W., & Willkomm, B. (1996). Simulator-based test systems as a measure to improve the prognostic value of aircrew selection. *Selection and Training Advances in Aviation: AGARD Conference Proceedings 588* (pp. 15-1–15-4). Prague, Czech Republic: Advisory Group for Aerospace Research & Development.

Hansen, D., & Wolf, G. (2000). Aircrew selection in the German Air Force. *Modern Simulation and Training, 1*, 26–30.

Olea, M. M., & Ree, M. J. (1994). Predicting pilot and navigator criteria: Not much more than *g*. *Journal of Applied Psychology, 79*, 845–851.

Ree, M. J., & Carretta, T. R. (1996). Central role of *g* in military pilot selection. *The International Journal of Aviation Psychology, 6*, 111–123.

Schmidt, F. L., & Hunter, J. E. (1998). The validity and utility of selection methods in personnel psychology: Practical and theoretical implications of 85 years of research findings. *Psychological Bulletin, 124*, 262–274.

Weeks, J. L., & Zelenski, W. E. (1998). *Entry to USAF undergraduate flying training* (AFRL–HE–AZ–TR–1998–0077). Brooks AFB, TX: Training Effectiveness Branch, Warfighter Training Research Division, Air Force Research Laboratory.

Endnotes

1. Military aircrews are increasingly dependent upon methods by which they can effectively exploit new and updated information from off-board sources to improve situation/battlefield awareness and mission success. The RTIC concept provides this capability by allowing aircrews to receive accurate, mission essential information from a variety of off-board sources. RTIC provides timely and reliable information regarding defensive and offensive air-to-air and surface-to-air threats, hostile force locations, mission route and weather updates, and information on friendly forces, communications, support, and mission changes.
2. The U.S. Army test used for selection into helicopter training is called the Alternate Flight Aptitude Selection Test (AFAST). It has seven subtests that assess background characteristics, special aptitudes, and personality. The subtests are Self-Description, Background Information, Comprehension, Complex Movements, Helicopter Knowledge, Cyclic Orientation, and Mechanical Functions. The U.S. Navy’s Aviation Selection Test Battery (ASTB) is used to predict performance in the U.S. Navy, Marine Corps, and Coast Guard pilot curriculum. The six ASTB subtests assess background information, aptitude, and job knowledge. The ASTB subtests are Math/Verbal, Mechanical Comprehension, Spatial Apperception, Aviation and Nautical Information, Biographical Inventory, and Aviation Interest.
3. By comparison, the U.S. Air Force AFOQT requires about four hours to complete and the BAT another two hours.

The Human Systems Information Analysis Center (Human Systems IAC) is the gateway to worldwide sources of up-to-date human systems information for designers, engineers, researchers, and human factors specialists.

HSIAC's primary objective is to acquire, analyze, and disseminate timely information about human systems/ergonomics. The Human systems IAC offers five levels of user service:

- Basic Inquiry
- Search & Summary
- Review & Analysis
- Technical Area Task
- Meeting Administration

The Basic Inquiry offers limited technical service at no cost to the user to clarify and respond to a specific inquiry. Basic Inquires can be requested by contacting the Human Systems IAC Program Office:

Phone: (937) 255–2450
Fax: (937) 255–4823
E-mail: paul.cunningham2@wpafb.af.mil

Cost for other services are based on the technical nature and time involved. For information on products go to: http://iac.dtic.mil/hsiac/products/pstoc.html

let us hear from you

What can Human Systems Integration (HSI) do for Homeland Security?

After the tragic events of September 11th, many groups and organizations contributed time, effort, and resources to try to repair the damage done and to prevent terrorists from succeeding in the future. We as human systems professionals potentially can help in many ways.

We have expertise in many technical domains: human factors engineering (HFE), health hazards, safety factors, personnel survivability factors, manpower, personnel and training (MPT), medical factors, and habitability.

Unprecedented opportunities for collaboration between HSI and many other scientific and technical disciplines exist today, and those of us who publish the Gateway would be pleased to hear how you think the HSI community has, or could, support homeland security.

Suggested top-level categories include awareness and identification of terrorism, prevention of terrorism, preparing for disaster, crisis response/crisis management, and military response/readiness/deployment.

We would like to hear your ideas and will not attribute anything you are willing to share with us without your permission.

calendar

apr

A Coruna, Spain. April 15–18, 2002
Human Factors and Medicine Panel Symposium
On Spatial Disorientation in Military Vehicles: Causes, Consequences, and Cures. Open to Partners for Peace (PfP) nations. Tel: +33 15561 2262, Fax: +33 1 5561 2298.

Minneapolis, MN, USA. April 20–25, 2002
CHI 2002 Conference on Human Factors in Computing Systems
Contact: CHI 2002 Office, 703 Giddings Avenue, Suite U–3, Annapolis, MD 21401, USA. Tel: +1–401–263–5382, Fax: +1–410–267–0332, E-mail: CHI2002-office@acm.org, URL: http://www.acm.org/sigchi/chi2002

Chantilly, VA, USA. April 29–30, 2002
2nd Annual DoD Ergonomics Working Group Conference: Forging Ahead—Preventing Work-Related Musculoskeletal Disorders
Registration and conference information can be found on the web site URL: http://chppm-www.apgea.army.mil/ergowg/conference/

San Diego, CA, USA. April 29 – May 2, 2002
47th Meeting of the DoD Human Factors Engineering Technical Advisory Group
Contact: Ms. Sheryl Cosing, 10822 Crippen Vale Court, Reston, VA 20194, USA. Tel: +1–703–925–9791, Fax: +1–703–925–9694, E-mail: sherylynn@aol.com, URL: http://dtica.dtic.mil/hftag/meetschl.html

may

Montreal, Canada. May 5–9, 2002
Aerospace Medical Association Annual Scienficic Meeting
Queen Elizabeth and Sheraton Hotels. Contact Mr. Tom Clark. Tel: +1–757–437–1942, E-mail: exhmgr@aol.com, URL: http://www.asma.org/meetinginfo.html

Nashville, TN, USA. May 9–12, 2002
Army Aviation Association of America Annual Convention (Quad-A),.
Contact: AAAA, Westport, CT, USA. Tel: +1–203–226–8184, E-mail aaaa@quad-a.org

Orlando, FL, USA. May 19–22, 2002
IIE Annual Conference 2002
Contact: Institute of Industrial Engineers, 25 Technology Park, Norcross, GA 30092, USA. Tel: +1–800–494–0460 or +1–770–449–0460, Fax: +1–770–441–3295, URL: http://128.241.229.4/public/articles/index.cfm?Cat=265

Boston, MA, USA. May 19–24, 2002
SID 2002: Society for Information Display
Contact: SID, c/o Palisades Institute for Research Services, Inc., 411 Lafayette Street, 2nd Floor, New York, NY 10003, USA. Tel: +1–212–460–8090, Fax: +1–212–460–5460, E-mail: wklein@palisades.org, URL: http://www.sid.org

Boston, MA, USA. May 29 – June 1, 2002
6th International Conference on Cognitive and Neural Systems
Contact: Cynthia Bradford. E-mail: cindy@cns.bu.edu, URL: http://www.cns.bu.edu/meetings/

jun

Toronto, Canada. June 10–13, 2002
XVI International Annual Occupational Ergonomics & Safety Conference
Contact: Dr. Sourin P. Dutta, Conference Chair, ISOES Annual Conference 2002, Department of Industrial and Manufacturing Systems Engineering, University of Windsor, Windsor, Ontario, N9B3P4 Canada. Tel: +1–519–253–3000, ext. 2608, Fax: +1–519–973–7062, E-mail: sdutta@uwindsor.ca or caisoes@uwindsor.ca, URL: http://www.uwindsor.ca/isoes

Huntsville, AL, USA. June 11–13, 2002
Army T& E Days 2002—Responding to Asymmetrical Warfare: The New Reality for Army Test and Evaluation
Contact: Ms. Sherry Hilley. Tel: +1–256–842–6715, (DSN 788), E-mail: shilley@rttc.redstone.army.mil, URL: http://www.testevaldays.com

# of events

Munich, Germany. June 18–20, 2002
SAE Digital Human Modeling for Design and Engineering (DHM)
Contact: John R. Miller, SAE, 755 West Big Beaver Road, Suite 1600, Troy, MI 48084–4096, USA. Tel. +1–248–273–2464, Fax: +1–248–273–2494, E-mail: jrmiller@sae.org,
URL: http://www.sae.org/calendar/gvmtgs.htm

jul

Orlando, FL, USA. July 8–12, 2002
11th Annual UPA Conference
Contact: UPA Conference Office, Prestige Accommodations, 1518 Brookhollow Drive, Suite 23, Santa Ana, CA 92705, USA. Tel: +1–800–321–6338 or +1–714–957–9100,
E-mail: registration@prestigeacc.com,
URL: http://www.righiinterface.com/upatestsite/conf_upa2002.htm

sep

Elephant and Castle, London, UK. September 2–6, 2002
The 16th British HCI Group Annual Conference Incorporating European Usability Professionals' Association Conference 2002
URL: http://cise.sbu.ac.uk/hci2002/index.html

Pisa, Italy. September 18–20, 2002
4th International Symposium on Human Computer Interaction with Mobile Devices
URL: http://giove.cnuce.cnr.it/mobilehci02.html

Jacksonville, FL, USA. September 30 – October 2, 2002
2002 SAFE Symposium
URL: http://www.safeassociation.com/2002symposium1.htm

Baltimore, MD, USA. September 30 – October 4, 2002
HFES 46th Annual Meeting
Pittsburgh Hilton and Towers. Contact: HFES Office, P.O. Box 1369, Santa Monica, CA 90406–1369, USA. Tel: +1–310–394–1811, Fax +1–310–394–2410, URL: http://hfes.org

oct

San Diego, CA, USA. October 7–9, 2002
90th Annual Congress & Expo
Contact: National Safety Council, 1121 Spring Lake Drive, Itasca, IL 60143–3201, USA. Tel: +1–630–285–1121, Fax: +1–630–285–1315, URL: http://www.nsc.org/expo02\call.htm

MIT, Cambridge, MA, USA. October 23–25, 2002
HCI-Aero Human-Computer Interaction in Aeronautics
Contact: HCI-Aero 2002 Office, European Institute of Cognitive Sciences and Engineering (EURISCO), 4 Avenue Edouard Belin, 31400 Toulouse, France. Tel: +33 (0) 5 62 17 38 38, Fax: +33 (0) 5 62 17 38 39, E-mail: hci-aero2002@onecert.fr
URL: http://www-eurisco.onecert.fr/events/hci-aero2002.html/

dec

Orlando, FL, USA. December 2–5, 2002
I/ITSEC Interservice/Industry Training, Simulation, and Education Conference
Orange County Convention Center on International Drive.
URL: http://www.iitsec.org/poc.htm

Screening the Screeners: Improving Airport Passenger and Baggage Screening

Joe W. McDaniel, Ph.D., CPE

The devastating terrorist attacks beginning on 11 Sep 2001 have changed the character of security at airports. Unfortunately, human error continues to cause high-visibility failures in the passenger and baggage screening system. The human systems integration (HSI) community would like to contribute to homeland defense, and problems related to human error, manpower, personnel, and training are all areas in the HSI domain.

Despite the critical emphasis recently placed on security, there have been some startling failures, such as the 3 Nov 2001 incident when a man with a carry-on bag full of weapons was cleared through the Chicago airport security. Although the airport screening equipment was operating normally, the failure was the result of human error.

On 19 Feb 2002 a screener fell asleep at the Louisville airport causing 15 flights to be delayed and about 1,000 passengers to undergo rescreening. What is the problem here? Selection? Sleep deprivation? Rotating shifts? Training? Human factors research has a wealth of scientific data on circadian rhythms, work/rest schedules, and vigilance. More important, human factors tools and techniques have proven useful in reducing human error in critical jobs.

Everyone has an opinion on the subject of airport screening. Some believe that airport screeners should be retirees because they have a better work ethic, emotional control, and a fondness for routine. However, others believe that retired people have poorer vision and are more likely to fall asleep.

When the federal government assumes control of airport security, it will not be under the FAA, but the newly formed Transportation Security Administration (TSA) of the Department of Transportation (DOT). The government is reported to be worried about finding enough qualified people to fill the 40,000 openings for screener positions. Applicants for the new posts must be U.S. citizens, speak and write English proficiently, have 40 hours of training (up from the current 12 hours) and possess a high school diploma or have one year of any type of work experience that demonstrates the applicant's ability to perform the work of the position. The TSA is developing a federal aptitude test that is supposed to measure aptitude necessary to conduct screening; ability to deal effectively with the public and English proficiency. This is one area where the human systems community may be able to assist.

A 25 Sep 2001 General Accounting Office report (GAO–01–1171T) said:

> *Turnover exceeded over 100 percent a year at most large airports, leaving few skilled and experienced screeners, primarily because of the low wages, limited benefits, and repetitive, monotonous nature of their work. Additionally, too little attention has been given to factors such as the sufficiency of the training given to screeners. Two conditions—rapid screener turnover and inadequate attention to human factors—are believed to be important causes. From May 1998 through April 1999, screener turnover averaged 126 percent at the nation's 19 largest airports; 5 of these airports reported turnover of 200 percent or more, and 1 reported turnover of 416 percent. At one airport we visited, of the 993 screeners trained at that airport over about a 1-year period, only 142, or 14 percent, were still employed at the end of that year. Such rapid turnover can seriously limit the level of experience among screeners operating a checkpoint. Both FAA and the aviation industry attribute the rapid turnover to the low wages and minimal benefits screeners receive, along with the daily stress of the job. Generally, screeners are paid at or near the minimum wage.*

The solution will require some time and competent researchers to systematically evaluate the specific job requirements and identify quantifiable characteristics and abilities of potential screeners.

Working against a systematic approach to solving this problem is the urgency of hiring a new workforce. On the other hand, the high turnover rate allows tuning the process for future generations of screeners.

When the military brings in a new recruit, the applicant's physical qualifications, aptitude and moral standards are tested. To do this testing, the military has 65 Military Entrance Processing Stations (MEPS) in 42 states (including Alaska and Hawaii) and Puerto Rico, most of which are located in or near major cities, and a short distance from the major airports. This is not to say the TSA will want help from the MEPS, but the MEPS might serve as a model of an effective system.

Every job in the military has tailored requirements specific for the needs of that particular job, including vision, hearing, strength, and mobility. Many military jobs require clean medical, psychological, drug, and criminal history. This is similar to the requirements for airport screeners. Over several decades, the MEPS have developed effective screening technology available for all these factors. Furthermore, the military has specialists that periodically survey and update job requirements, performing task analyses, surveys, job inventories. The military has specialists for developing and validating performance-based selection tests.

After entering the service, recruits are sent to a technical school that prepares them for the new job. The instruction material is based on analyses of actual job requirements. The military has specialists that translate job requirements into training requirements and develop the curricula. To be promoted, military members are tested on the technical requirements for the job, but they are also tested for leadership skills. In summary, the military has a job-specific selection, training, and promotion infrastructure that works extremely well. Additionally, the military has periodic physical fitness tests to maintain a healthy, fit force (these were described in the last special issue of the *Gateway* Vol. XII: No. 4, 2001). In the human systems domain, these technologies are referred to as MPT (manpower, personnel, and training).

Proper selection and training is one side of the human-machine interface. The other side is the design of the workplace itself, specifically, the operator's interface to the "machine." Assuming an airport x-ray machine has the ability to show the operator a picture of sufficient resolution to identify a hazardous object inside luggage, the effectiveness of the system design depends on factors such as the display's resolution, size, viewing distance, contrast, color, location, ambient lighting, and the environment of operation.

Airports have a great variation in the location and orientation of x-ray displays. Some displays are located so they require the operator to lean forward and look down, while others require short operators to look up at the display. Operators are often located in high traffic areas that might interfere with concentration and attention. Human factors engineers have design guidelines for display workstations and information regarding how long someone should screen before attention wanes.

Human factors engineers routinely address all these issues. Sometimes a fresh approach is needed. We need to ask, how should an x-ray operator's workstation be designed to maximize operator effectiveness in detecting hazardous objects inside luggage? However, when technology is not designed with the human operators in mind, or if the human operators are selected without the aptitudes to operate the technology, errors will be induced that negate the effectiveness of the technology.

Human error will always be part of a system that uses humans for work. Human factors engineers have learned techniques to minimize that error, and to use safeguards that minimize the consequences of human error. In recognizing the human component of all systems, we are able to develop human interfaces that do not induce human error, while providing feedback to make immediate errors conspicuous and provide an effective means of correcting small errors before the system fails. ■

For further information, please contact:

Dr. Joe McDaniel

Tel: (937) 255–2558
DSN: 986–2558
E-mail: joe.mcdaniel@wpafb.af.mil

Joe W. McDaniel, Ph.D., CPE
Principal Industrial Engineer
Crew Systems Development Branch
Human Effectiveness Directorate
Air Force Research Laboratory

2210 8th Street, Bldg. 146
Wright-Patterson AFB, OH 45433–7511

address needed!

If your address label does NOT include a complete street address, P.O. Box, or ZIP code, please provide us with this information. We are trying to comply with the regulations of the U.S. Postal Service. Without this information we cannot guarantee your continued receipt of the Human Systems IAC GATEWAY. Please E-mail changes to roseann.venis@wpafb.af.mil or mail changes to:

Human Systems IAC GATEWAY
AFRL/HEC/HSIAC Bldg 196
2261 Monahan Way
WPAFB, OH 45433–7022

Train the Way We Fight?

Major Todd Heinle

For further information, please contact:

Major Todd Heinle
Tel: (937) 656–7011
DSN: 986–7011
E-mail: todd.heinle@wpafb.af.mil.

Major Todd Heinle, is the Program Manager of AFRL's Spatial Disorientation Countermeasures group. Additional information regarding SD can be found at *http://www.spatiald.wpafb.af.mil*

For years now, operations personnel have said that we need to train the way we intend to fight. Consequently, training scenarios are as realistic as possible, with very little simulated action. How else can the student recognize the flow? Certainly, air traffic controllers train with the maximum number of aircraft in the traffic pattern. How else can they develop the skills to manage real situations? Without a doubt, pilots discuss the intricacies of landing in a crosswind, but they also actually fly approaches in crosswinds so they can recognize the conditions. The absolute best way to learn to parallel park is to do it with the guidance and assistance of a competent instructor.

If practical, hands-on learning is so well accepted in most every instructional setting, why then do we teach new aircrew members about spatial disorientation (SD) only by talking to them for an hour, maybe two, and then demonstrating SD to one or two of them in a Barany chair? Why not actually train inexperienced aircrew to recognize the situations that lead to SD, and the symptoms of having it, in a realistic environment?

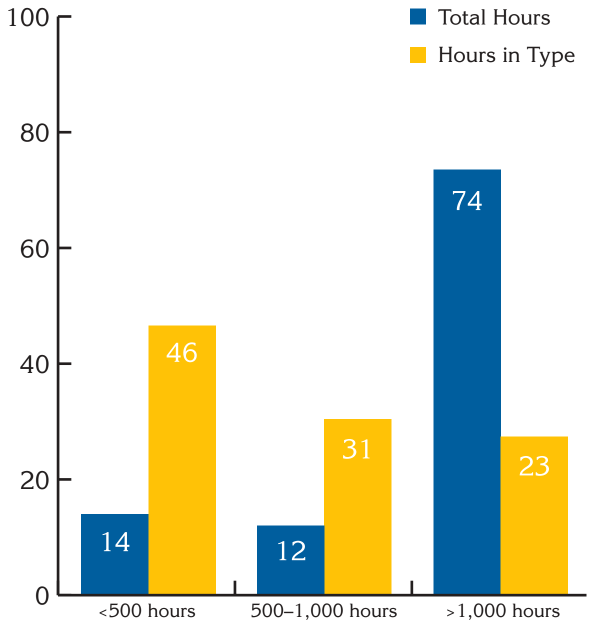
SD has been broken up into three types: Type I (unrecognized), Type II (recognized) and Type III (incapacitating). Historically, 70 to 80 percent of aircraft mishaps that are SD-related are Type I. Type II accounts for approximately three percent, and Type III SD is statistically insignificant. The mishaps in the remaining 17–27 percent cannot be classified into one of the three types.

Put another way, 70 to 80 percent of the time an SD mishap occurs, the aircrew member is unaware that there is a problem. Or to put it into simpler terms, they are "unaware and unafraid" before tragedy strikes. The essential point is recognition of the SD symptoms. How do you fix a problem if you do not know you have a problem? And how do you know you have SD if you have never experienced the actual conditions?

The Air Force Research Laboratory's (AFRL's) SD Countermeasures program is currently building SD flight profiles in collaboration with the U.S. Army, Royal Air Force, Air National Guard, and the Navy Test Pilot School. The goal is to produce profiles useable either in the air or in an aircraft simulator that will reproduce the flight situations when SD is most likely to occur. Instructors can then either fly the entire SD profile, or better yet, insert specific maneuvers into existing training missions and allow the students to recognize how SD can occur during routine operations.

By exposing aircrew to the environment and then the actual SD illusion in a controlled situation, the aircrew will be more experienced about the conditions leading to SD, and ultimately trained to overcome the event when encountered. In this way, we plan on reducing that 70–80 percent of unrecognized SD mishaps.

The first step is recognition. SD is most likely to occur when a pilot is new to an aircraft. It has often been stated that SD can happen at any experience level, at any time, as is shown in Figure 1 by the breakout of total hours of the crewmembers involved in Class A mishaps involving SD from 1990 to 1999. Seventy-two percent of these mishaps occurred to crewmembers having greater than 1,000 total flight hours. However, this does not mean that more experienced pilots experience SD more often. If the data from that same time period is broken down into hours in type of aircraft, approximately 75 percent of these SD related mishaps happened to crewmembers having less than 1,000 hours in that particular type of aircraft. In other words, when changing from one aircraft



*The scale for >1000 hours is noncontiguous, because it includes all Class A SD mishaps above 1000 hours, and as such, is not a 500 hour increment.

Figure 1. Percentage of SD Mishaps by Flight Time (based on 1990–1999 USAF Safety Center data).

type to another, an experienced pilot to some degree reverts to beginner status.

Using this different outlook, the SD Countermeasures program is focusing on developing training profiles, primarily for the undergraduate (UFT) level, but with additional follow-on training at the aircraft-specific Flying Training Units (FTUs). The objective is to improve effectiveness with early intervention—when a pilot is first starting out in a new aircraft. That way they can learn to effectively fight killer SD by training to do so at the outset. Wish us luck, because we expect all pilots to benefit from this SD training! ■

email?

Would you like to receive your copy of *GATEWAY* by E-mail? If so, please E-mail your address to roseann.venis@wpafb.af.mil.

products

HSIAC

If you have any questions concerning this product list, please access our web page http://iac.dtic.mil/hsiac or contact Lisa McIntosh at: Tel: (937) 255–4842, DSN: 785–4842, Fax: (937) 255–4823.

Product	Unit Price
50 Years of Human Engineering Book	N/C
50 Years of Human Engineering CD	$20.00
Anthropometric Data Analysis Sets (ADA)	$100.00
Application of Human Performance Models to System Design	$60.00
Biological Psychology Special Issue	$25.00
CASHE: PVS Software for MAC Computers	$395.00
Colloquium Videotapes	$25.00
Color in Electronic Displays	$45.00
Electronic Imaging Proceedings	N/C
Engineering Data Compendium including User's Guide	$295.00
Engineering Data Compendium User's Guide ONLY	$65.00
HSIAC Gateway Newsletter	N/C
Human Factors Definitions	N/C
NASA TLX Paper & Pencil Version	$20.00
NASA TLX Computer Version (DOS Version)	$20.00
Directions in Performance Assessment	$25.00
Perception & Control of Self Motion	$29.95
SOAR: Analysis Techniques for Human – Machine System Design	$45.00
SOAR: Behind Human Error	$39.00
SOAR: Computational Models of Human Performance	$39.00
SOAR: Human Factors Engineering in System Design	$35.00
SOAR: Improving Function Allocation	$39.00
SOAR: Naturalistic Decision Making	$35.00
SOAR: The Process of Physical Fitness Standards Development	$45.00
SOAR: Situational Awareness in the Tactical Air Environment	$45.00
SOAR: Strategic Workload	$35.00
SOAR: The Book of HUD	$35.00
SWAT (DOS Version)	$50.00

PROGRAM OFFICE
AFRL/HEC/HSIAC BLDG 196
2261 MONAHAN WAY
WRIGHT-PATTERSON AFB OH 45433–7022

http://iac.dtic.mil/hsiac

(937) 255–4842 Telephone
(937) 785–4842 DSN
(937) 255–4823 Facsimile
(937) 255–2558 Gov. Tech Manager

DEPARTMENT OF THE AIR FORCE
OFFICIAL BUSINESS

Thomas Metzler, *Director*

Dr. Michael Fineberg, *Chief Scientist*

Dr. Joe McDaniel, *Gov. Technical Manager*

Tanya Ellifritt, *Assoc. Gov. Technical Manager*

Dr. Kenneth R. Boff, *Gov. Technical Director*

Human Systems IAC **GATEWAY** is published and distributed free of charge by the Human Systems Information Analysis Center.

RoseAnn Venis, *Editor*
Ahnie Senft, *Art Director & Graphic Artist*